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IS 6134-2 (1973): Methods of measurement of electrical characteristics of microwave tubes, Part 2: Oscillator tubes [LITD 4: Electron Tubes and Display Devices]



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IS : 6134 (Part II) - 1973

Indian Standard
METHODS OF MEASUREMENTS ON
MICROWAVE TUBES
PART II OSCILLATOR TUBES

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Indian Standard

METHODS OF MEASUREMENTS ON MICROWAVE TUBES

PART II OSCILLATOR TUBES

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Indian Standard
**METHODS OF MEASUREMENTS ON
MICROWAVE TUBES**

PART II OSCILLATOR TUBES

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 23 April 1973, after the draft finalized by the Electron Tubes Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard deals with the methods of measurements of characteristics of microwave oscillator tubes which are common to the family of oscillator tubes. The measurements described in this standard are either in addition to or alternate to those given in Part I of this series of standards on microwave tubes measurement. Specific types of oscillator tubes will be dealt with separately to which this standard and Part I of this series will form necessary adjuncts.

0.3 While preparing this standard, assistance has been derived from Pub 235-2 'Measurement of the electrical properties of microwave tubes, Part 2 General Measurements', issued by the International Electrotechnical Commission.

0.4 This standard is one of a series of Indian Standards on microwave tubes. A list of standards published so far on microwave tubes is given on fourth cover.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part II) deals with methods of measurements of characteristics of microwave oscillator tubes which are common to the family of oscillator tubes.

*Rules for rounding off numerical values (revised).

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1.1.1 Specific types of oscillator tubes, such as klystron oscillator tubes, diskseel tubes are dealt with separately.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions given in IS : 1885 (Part IV/Sec 3)-1971* shall apply.

3. GENERAL CONDITIONS

3.0 The provisions of IS : 6134 (Part I/Sec 1)-1971† shall apply.

4. FREQUENCY

4.1 Frequency Pulling Figure

4.1.1 This is measured with the tube operative under stated conditions when coupled into a load causing a stated voltage standing wave ratio (VSWR).

4.1.2 The frequency pulling figure is the difference between the extremes of frequency of oscillation which occur when the phase of the reflection coefficient of the load is varied through 2π radians.

NOTE — It should be ensured that the range for the phase variation is fully covered.

4.1.3 Precautions — Care should be taken that the VSWR remains between stated limits during variation of the phase of the reflection coefficient of the load, and that the rate of change of phase is rapid enough to avoid thermal drift effects. It may be necessary to state the distance between the output plane of the tube and the reference plane of the load.

4.2 Frequency Pushing Figure — This is measured by varying the electrode current periodically under the stated operating conditions. The difference between the extremes of frequency of oscillation throughout the stated current variation is measured. The frequency pushing figure is computed as the ratio between this difference in frequency, and the magnitude of the current variation.

4.2.1 Pulse Operation — The amplitude of the electrode current pulse is periodically modulated, usually sinusoidally, at such a rate that thermal effects may be neglected, provision being made to measure the difference in the peak values of the current due to modulation. The frequency change may be measured by a spectrum analyser or by a microwave receiver. The result is expressed as the ratio between the change in frequency, and the maximum difference between current peaks during a modulation cycle.

*Electrotechnical vocabulary : Part IV Electron tubes, Section 3 Microwave tubes.

†Methods of measurement on microwave tubes : Part I General measurements, Section 1 General conditions and precautions for measurements.

4.2.2 CW Operation — The electrode current is modulated smoothly, at least over the required range, at such a rate that thermal effects may be neglected. A frequency discriminator of high enough resolution to resolve the expected frequency difference is required. The output of the frequency discriminator is applied to one axis of a cathode-ray oscilloscope and the electrode current signal is applied to the other axis. The axis representing current is calibrated in such a way that the instantaneous frequency at all values of current can be observed.

4.3 Temperature Coefficient of Frequency — When operated under stated conditions, the frequency of oscillation is measured at two stated temperatures observed at a prescribed point on the body of the tube. The temperature variations can be produced by external means. The result is expressed as the ratio of the difference in frequency to the difference in temperature.

5. SPURIOUS MODE OSCILLATION

5.1 The existence of oscillation in spurious modes in the output and the power of this oscillation, may be checked by a spectrum analyser or by a microwave receiver. If an attenuator is used, it is inserted before the first mixer. In comparing the output in desired and spurious modes, the sensitivity *versus* frequency characteristics of the entire system including waveguide components and the spectrum analyser of receiver should be carefully calibrated.

6. PULSE STABILITY

6.1 Missing Pulses

6.1.1 Missing rf pulses may be recorded during a known time interval by an electronic counter activated by a circuit that detects missing rf pulses. The rectified rf pulse input to the circuit may be sampled from the tube load through a frequency selective device of suitable passband. The reference input to the circuit should be representative of the input pulse applied to the tube. The missing pulse detector employed should be capable of recording random and occasional deficient pulses, as well as consecutive clusters of deficient pulses.

6.1.2 The modulator, the load and other operating conditions should be kept constant during the measurement so that missing pulses are caused only by the tube being measured.

6.2 Pulse Mismatch Stability

6.2.1 Mismatch stability is measured as described in **6.1** with the load having a VSWR of stated value. A maximum value of the missing pulse

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factor is found by varying the phase of the reflection coefficient of the load at least by 2π radians.

NOTE — It should be ensured that the range for the phase variation is fully covered.

6.2.2 It may be necessary to state the distance between the output plane of the tube and the reference plane of the load, because this influences the Q-factor (long line effect) of the circuit which in turn can affect the stability of an oscillator.

6.3 Starting Stability of Snap-on-Stability — Measurement of starting stability of a pulsed generator is performed as the first measurement following a stated period of inactivity. The stated pulse voltage is applied instantaneously and observations of the missing pulse factor are made as described in **6.1**.

INDIAN STANDARDS ON MICROWAVE TUBES

IS :

- 1885 (Part IV/Sec 3)-1971 Electrotechnical vocabulary: Part IV Electron tubes, Section 3 Microwave tubes
- 1885 (Part IV/Sec 5)-1972 Electrotechnical vocabulary: Part IV Electron tubes, Section 5 Pulse terms
- 1885 (Part IV/Sec 6)-1972 Electrotechnical vocabulary: Part IV Electron tubes, Section 6 Noise in microwave tubes
- 2032 (Part XIII)-1971 Graphical symbols used in electrotechnology: Part XIII Microwave tubes
- 6134 (Part I/Sec 1)-1971 Methods of measurement on microwave tubes: Part I General measurements, Section 1 General conditions and precautions for measurements
- 6134 (Part I/Sec 2)-1972 Methods of measurements on microwave tubes: Part I General measurements, Section 2 Common to all devices
- 6134 (Part II)-1973 Methods of measurements on microwave tubes: Part II Oscillator tubes
- 6134 (Part III)-1973 Methods of measurements on microwave tubes: Part III Amplifier tubes

NOTE — For a complete list of Indian Standards on Electron Tubes, reference may be made to ISI Handbook.

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